Advant® OCS
with Master software

Redundant Disk Array

User’s Guide

Use of **DANGER**, **WARNING**, **CAUTION**, and **NOTE**

This publication includes, **DANGER**, **WARNING**, **CAUTION**, and **NOTE** information where appropriate to point out safety related or other important information.

DANGER	Hazards which could result in severe personal injury or death
WARNING	Hazards which could result in personal injury
CAUTION	Hazards which could result in equipment or property damage
NOTE	Alerts user to pertinent facts and conditions

Although **DANGER** and **WARNING** hazards are related to personal injury, and **CAUTION** hazards are associated with equipment or property damage, it should be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process performance leading to personal injury or death. Therefore, comply fully with all **DANGER**, **WARNING**, and **CAUTION** notices.

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Chapter 1 Introduction

1.1 General Information

The Redundant Disk Array (RDA), Figure 1-1, is an external drive unit that uses **R**edundant **A**rray of **I**ndependent **D**isks (RAID) technology to provide the utmost in reliability and data availability in the system. The RDA unit can hold 3 pairs (ranks) of disk drives. ABB adds the RDA unit to the Advant® Station 500 Series workstations to meet industrial requirements of process plant operations.

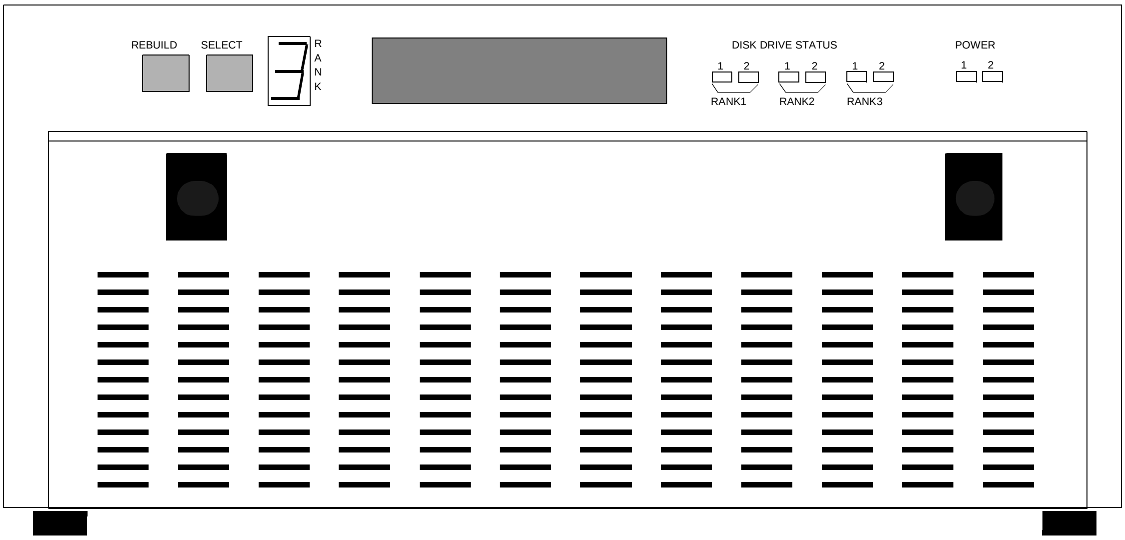

Figure 1-1. Redundant Disk Array

The RDA with an Advant Station 500 Series workstation performs a wide variety of functions when combined with basic software and Advant technology applications. Available software packages are, for example, AdvaCommand® software.

This guide explains how to install and operate the RDA unit, a **F**eature **F**ault **T**olerant (FFT) disk subsystem that provides the utmost in hardware reliability and data availability.

This guide provides detailed information for using the RDA unit on a the Advant Station 500 Series workstations. It also describes the unit’s front panel and gives you an understanding of the various messages that may be displayed on the LCD screen.

Use this guide to operate the RDA unit, to learn about the buttons and lights on the front panel, and to gain an understanding of the various messages that may be displayed on the LCD screen.

This guide is intended for system administrators who are responsible for maintaining the RDA unit on their system. A system administrator should understand the basic operation and administration of their Advant Station 500 Series workstations.

This manual provides a general physical and functional description of the Redundant Disk Array hardware and provides information for installation, service, and maintenance. It is also intended to support Advant® OCS training courses offered by ABB.

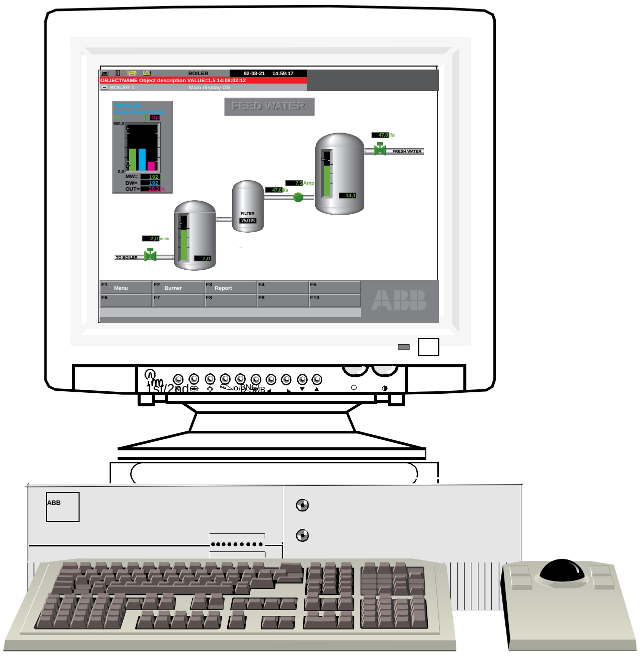

Figure 1-2. Advant Station 520 Configured as an ABB Master Operator Station

1.2 Equipment Requirements

Equipment requirements for the Advant Station vary, depending on your required functionality (operator station, batch station or information management station). Refer to the applicable station-level instruction book as described in Section 1.5 Related Documents for details.

1.3 Manual Organization

This book is organized into chapters and sections as shown in Figure 1-3. Some sections may not be applicable for this book.

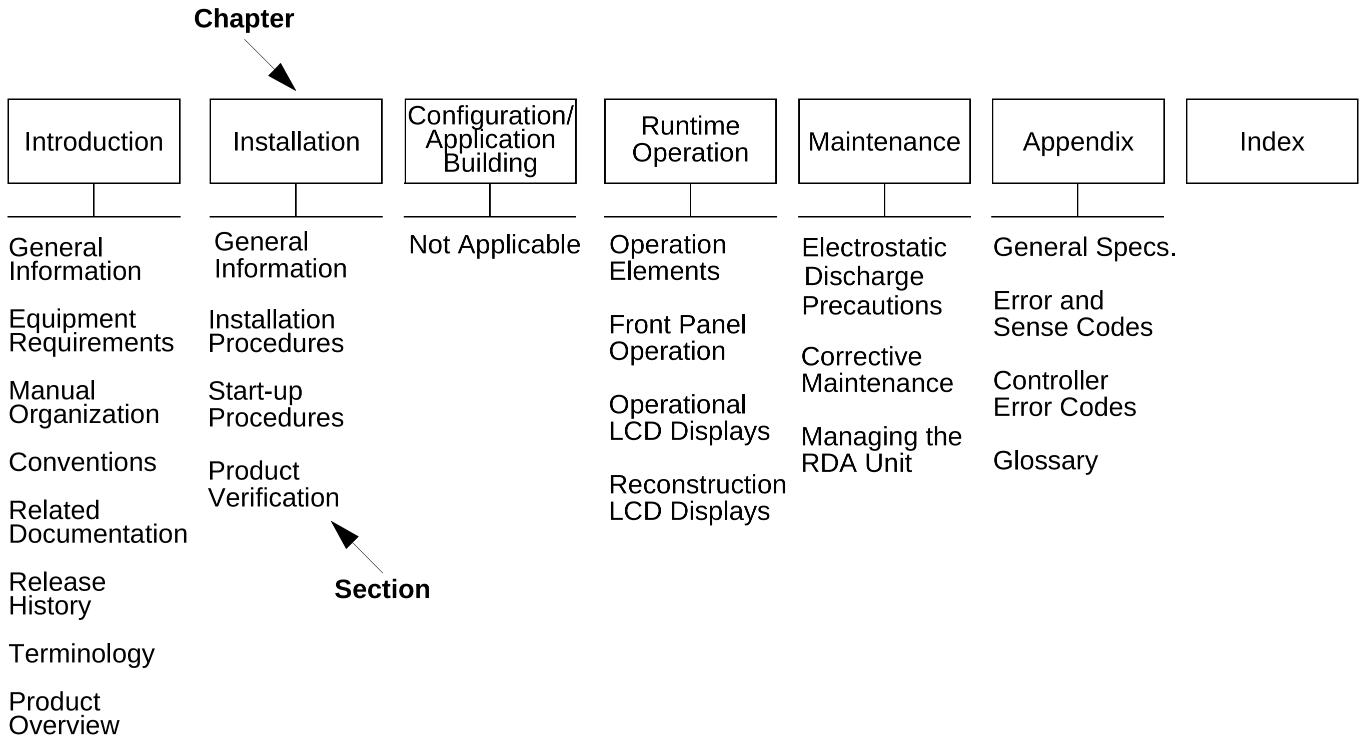

Figure 1-3. Manual Organization Diagram

Chapter 1. Introduction
This chapter introduces the Redundant Disk Array and describes its features.

Chapter 2. Installation
This chapter describes some of the physical aspects of the RDA unit and will give you an understanding of how to start-up the unit and use the unit’s front panel.

Chapter 3. Configuration/Application Building
This chapter does not apply to this document.

Chapter 4. Runtime Operation
This chapter describes the status and information messages that appear on the LCD screen and how to reconstruct a hard drive.

Chapter 5. Maintenance
This chapter discusses how to manage the RDA unit.

Appendix A. Specifications
This appendix provides the specification of the RDA unit.

Appendix B. Drive Error Codes
This appendix explains the meaning of the drive error codes that may be displayed by the RAID controller in the LCD window during drive failure.

Appendix C. Controller Error Codes
This appendix lists the possible sense key/additional sense code/ additional sense code qualifier values returned by the RAID controller.

Appendix D. Glossary
This appendix provides a listing of words used in this document.

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1.4 Conventions

The following notation conventions are used in this guide:

- Text that appears on the LCD screen is shown as follows:

```
ECCS RAID Module
(c) 1993 R1.0.A
```

- Keys or buttons that you must press are shown as all caps in a bold font, as follows:

Press the **SELECT** button.

1.5 Related Documents

For information regarding the software for operator station (OS), batch station (BS), information management station (IMS) or hardware, refer to the appropriate product manual:

- Advant Station 510 Hardware User’s Guide (OS)
- Advant Station 515 Hardware User’s Guide (OS, BS, IMS)
- Advant Station 520i Hardware User’s Guide (OS, IMS)
- Advant Station 530 Hardware User’s Guide (IMS)
- Advant Station Operator Station User’s Guide
- Advant Station Information Management Station User’s Guide

For specific information regarding the workstation itself, which is Model 715/33 for Advant Station 510 and Model715/50 for Advant Station 515, refer to the *HP Apollo 9000 Model 715/33 andModel 715/50 Owner’s Guide* manual (HP Part No A2084-90601). This manual is shipped with your system.

For specific information regarding the workstation itself, which is HP 9000 Model 747i for Advant Station 520i, refer to the *HP Apollo 9000 Model 745i/747i Owner’s Guide for HP-UX Users* manual (HP Part No A2261-90014). This manual was shipped with your system.

The following documents are published by ECCS and can be ordered by writing to ECCS Inc.

- ECCS RAID Module FFT-1 Administration Guide.
  This manual provides introductory information for using the ECCS RAID Module FFT-1 family.

- ECCS RAID Module, Vanity II Controller, Technical Reference Manual, Revision V2-001. This manual provides in-depth information required to integrate the ECCS RAID Module subsystem into your computer system. This manual supplements the information presented in the ECCS RAID Module FFT-1 Administration Guide.

1.6 Release History

This manual corresponds to:

First release of the Redundant Disk Array.

Second release with:

- larger capacity drives
- use with the AS510 OS
- use with IMS version 1.2 on the AS515 IMS, AS520i IMS and AS530 IMS

1.7 Terminology

1.7.1 Acronyms Used In This Guide

The following acronyms and/or abbreviations are used in this guide:

ANSI	American National Standards Institute
ECC	Error Correction Code.
GB	gigabyte (2^{30} or 1,073,741,824 bytes).
Hz	hertz (vibrations per second).
I/O	Input/Output signal.
IOPS	Input/Output operations per second.
KB	kilobyte (2^{10} or 1,024 bytes).
LCD	Liquid Crystal Display.
LED	Light Emitting Diode.
LUN	Logical Unit Number.
MB	megabyte (2^{20} or 1,048,576 bytes).
ms	millisecond (0.001 second).
MSG	Message signal.
MTTR	Mean Time To Repair.
RAID	Redundant Array of Independent Disks.
RAM	Random Access Memory.
SCSI	Small Computer Systems Interface.

µs	microsecond (0.000001 second).
xxh	hexadecimal values

1.8 Product Overview

1.8.1 General

The most fragile component of a computer system is usually its disk subsystem. Most system crashes are related to failures in the disk drives.

RAID, an acronym for **R**edundant **A**rray of **I**ndependent **D**isks, is a revolutionary new technology that has been developed to address this problem. RAID was created to provide higher reliability and performance for disk subsystems. Simply put, it is a subsystem consisting of multiple disks which spreads and shares data among the various drives. There are various versions of RAID, known as level *0* through *5*. RAID level *1* is commonly referred to as RAID1.

The RDA Unit is a Feature Fault Tolerant RAID1 disk subsystem designed to provide the utmost in hardware reliability and data availability. RAID1 technology, also called disk mirroring, consists of two drives working in parallel and containing, block by block, the same information. RAID1 offers excellent data protection, since in the event of either of the two drives failing, the same data is available from the mirrored drive. Feature Fault Tolerance (FFT) offers a high degree of subsystem redundancy for near-total fault tolerance. FFT means that critical features (functions) are backed up to continue operation if a part should fail.

1.8.2 RDA Unit Features

The RDA unit has the following features:

- **Disk Redundancy -** Fewer system failures and less downtime due to the ability of the subsystem to continue to operate when one drive has failed. A failed drive can be replaced at your convenience.
- **Data Reliability** - Since data sent to a logical drive is actually written onto two hard disk units, a RDA unit reduces data lost due to bad blocks or failed drives by the ability to reconstruct the information from other drives.
- **Transparent Mirroring Process -** The Mirroring Process is transparent to the Advant Station which sees the RDA Unit as an ordinary hard drive. This disk subsystem also reduces SCSI Bus traffic by 50% over software mirroring implementations during WRITE operations.
- **Hot-Swapping -** Hot-swapping is supported by the removable drives. This means a failed drive can be replaced without having to shutdown the system. The disk subsystem can also detect and correct bad blocks without intervention from the host computer.

- **Drive Status Information -** Through a Liquid Crystal Display (LCD) and six Light Emitting Diodes (LEDs) the user can see the status of the drives. The LCD will provide information regarding the condition and performance of the disk subsystem. The six LEDs indicate, by the use of colors (RED, GREEN and AMBER), the current operational condition of the drives.

- **Audible Alarm -** A beeper sounds if one of the drives in a rank fails. The sound is repeated every 10 minutes until both drives in that rank are operational.
- **Rebuilding Process -** Rebuilding of a newly replaced drive can occur simultaneously with normal system activity and is transparent to the system.
- **SCSI Interface Features -** SCSI Interface allows asynchronous data transfer rates up to 2.5 Mb/sec and synchronous data transfer rates to 5.0 Mb/sec. SCSI parity checking on the SCSI Buses insures reliable data transmission.
- **Variable Configurations -** The RDA unit is available in a 19" rack mount or table-top cabinet, with up to three ranks (pairs) of removable disk drive units. Configurations with one or two ranks can be expanded by adding more ranks.
- **Power Supply Redundancy -** The RDA unit is equipped with two power supplies. If one power supply fails, its LED will go off, and the second supply will keep the unit operational.

NOTE

The RDA Unit does not provide power conditioning or protection. If power line conditioners or uninterruptable power supplies are needed at your site, the RDA Unit should be protected in the same way as your system.

1.8.3 RDA Unit as External Mass Storage System

The Advant Station 500 Series may come equipped with a RDA unit. The RDA unit comes with its own cabinet and power supplies. The cabinet has low density SCSI-II input and output connectors. It must be connected to the SCSI-II device “OUT” connector on the Advant Station system unit.

The Redundant Disk Array can be a MP521 rack mount unit, or a MP522 table top unit. (See Table 1-1 for details).

Table 1-1. Redundant Disk Array Items

Equipment Items	Type Designation	Article No.
Redundant Disk Array unit, rack mounting	MP521	3BUC630002R0001
Redundant Disk Array unit, table top mounting	MP522	3BUC630003R0001
Redundant Disk Array unit, Console cabinet mounting	MP521K01	3BUR000626R0001
1.0 Gbyte hard disk drive ass’y.	MP523	3BUC630004R0001
2.0 Gbyte hard disk drive ass’y.	MP525	3BUC630005R0001
1.0 Gbyte hard disk set (2 drives)	MP524	3BUR000515R0001
2.0 Gbyte hard disk set (2 drives)	MP526	3BUR000612R0001

Table 1-1. Redundant Disk Array Items

Equipment Items	Type Designation	Article No.
Power Supply, removable	SD503	3BUC610002R0001
SCSI Cable, 304 mm (1 ft.)	TK554V003	3BUC950003R0001
SCSI Low Density Terminator	TX503	3BSC840081R0001

The Redundant Disk Array unit includes:

- a cabinet (rack or table top mounting) with redundant power supplies
- three RAID controllers to external SCSI connectors.
- Up to three MP524 1.0 GByte or MP526 2.0 GByte hard disk sets can be installed in the cabinet, providing up to a total of 6.0 GByte redundant mass storage.

Each set of disk drives can be connected to a different Advant Station 500 Series workstation or all three disk drive sets can be cabled to one Advant Station. The total cable length on a SCSI bus is set at 6 meters for a single-ended bus (must include external and internal cables).

NOTE

Each disk drive set installed in this cabinet occupies one address on a SCSI-II interface bus.

1.8.3.1 Power Distribution

The Advant Station 500 Series comes equipped with an SX520 Power Distribution Unit with IEC-320 compatible connectors and power cables. The power distribution unit is designed to reduce the impact of country-specific power cords by standardizing on the IEC-320.

The RDA unit should be plugged into the power distribution unit with a cord set supplied with the power distribution unit.

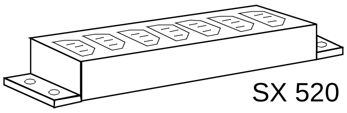


Figure 1-4. Power Distribution Unit

Chapter 2 Installation

2.1 General Information

The Redundant Disk Array unit is easy to install if you carefully follow the procedures outlined in this chapter.

This chapter provides information for:

- installation planning
  - site selection and preparation
  - power or cabling considerations
  - power requirements
- installation procedures
  - unpacking
  - RDA unit assembly (insertion of the disk-pack modules into the subsystem frame)
  - placement of equipment
  - switch settings
  - cabling
- Start-up procedures and product verification
  - powering up the system
  - formatting

Electrostatic Discharge (ESD) Precautions

Electrostatic discharge (ESD) can result from the buildup of static electricity on or around the components you handle. You can even carry a charge on your own body, and the discharge of this energy through a component or your computer can cause damage to the system.

CAUTION

Observe the following precautions at all times during removal and replacements tasks to prevent damage to the Advant Station system unit and peripheral equipment from ESD:

1. Stand on a static-free mat.
2. Wear a grounded static strap on your wrist to ensure that any accumulated electrostatic charge will be discharged from your body to ground.
3. Connect all equipment including static mat and strap, routing nodes, and peripherals to safety ground.
4. Keep all uninsulated printed circuit boards/cards in their protective antistatic bags.

5. Handle all printed circuit boards/cards by their edges, once you have removed them from their protective antistatic bags.

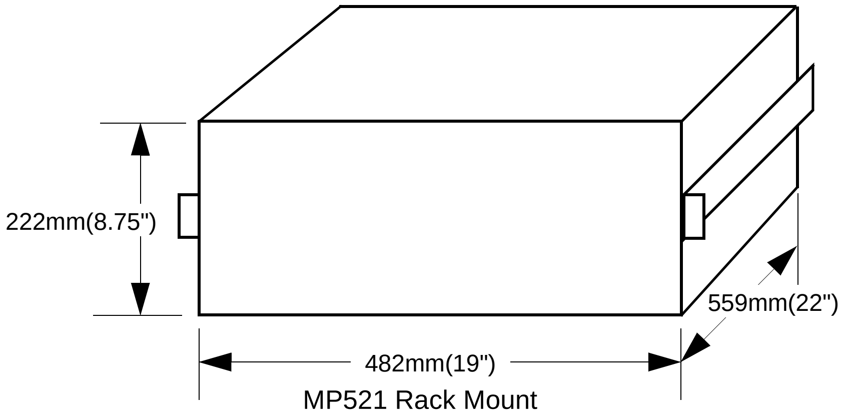
2.1.1 Installation Planning

2.1.1.1 Site Selection and Preparation

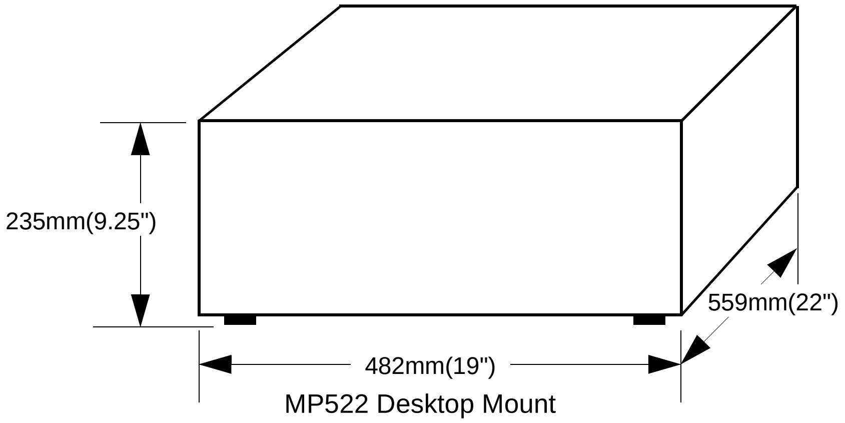
This section includes information for placement and space considerations.

2.1.1.2 RDA Unit Placement

The RDA unit is built for a control room environment. Refer to Appendix A Specifications for environmental information. The RDA MP521 may be set in 19" rack cabinets such as the 6000E series. The RDA MP522 unit may be installed flat on the desktop. The RDA MP522 unit may have equipment placed on top of it, such as the Advant Station's system unit. Figure 2-1 shows the dimensions of the RDA units. Rear cable connections require another 155mm (6") of space.



MP521 Rack Mount



MP522 Desktop Mount

Figure 2-1. RDA Unit Dimensions

2.1.2 Power and Cabling Considerations

The distribution of power to the RDA unit is via standard IEC 320 power cables. In this way most of the power cables are independent of national power outlets. Only one power plug will be dependent of the national power plug format. It is the plug that must be installed on the cable connecting the power distribution unit SX520 to the wall power outlet.

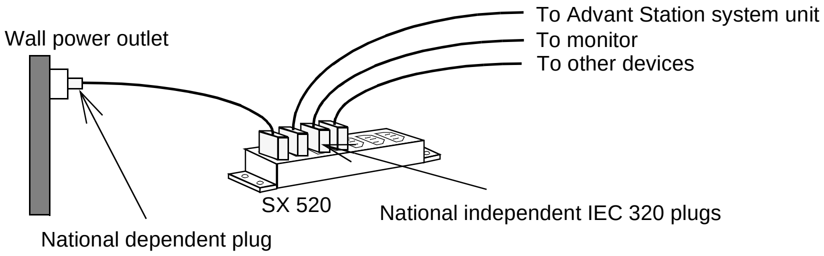


Figure 2-2. Power Distribution with IEC 320 power cables

Each equipment item is powered by an IEC-320 power cord from an SX520.

2.1.2.1 Power Input Voltage

Different equipment items have different input voltage ranges. Some items are made for 120V power input, others for 230V, and some have “autoselecting” voltage input. The selection of power range is made automatically inside the equipment.

The RDA unit has a selector switch at the back, on each of the power supply units. Refer to Section 2.2.6.1 for power supply unit switch settings.

CAUTION

Before connecting the RDA unit to the power line, be sure that the right voltage range is selected on each power supply unit!

2.1.2.2 Shielding and Grounding

For information regarding proper shielding and grounding, refer to ABB Automation publication “Installation Rules”, current order number 7650 203-203 or later. This publication presents “Installation Rules” to facilitate the work of system configuration for interference-free operation.

RDA unit should be powered from the same power outlet as the Advant Station system unit.

2.1.2.3 Termination of Cables

Termination of the SCSI bus cabling is required.

2.1.3 Power Requirements

The following table provides power requirements and heat generation data for building and support structures related to the RDA unit.

Table 2-1. Equipment Power Dissipation

Equipment	**Power Requirement**	**Equipped with internal fan**	**Power dissipation in watt maximum**
RDA unit, rack mounted, MP521	115/230 V ac, 47 - 63 Hz	Yes	200 W(1)
RDA unit, table top mounted, MP522	115/230 V ac, 47 - 63 Hz	Yes	200 W(1)

(1) Power dissipation with one rank (2 drives) installed. Each additional rank adds 18 watts.

2.2 Installation Procedures

This section describes how to unpack, assemble, mount, connect, and check out the RDA unit.

2.2.1 Installation Procedures Overview

The following overview shows the recommended sequence for installation procedures. Each of these procedures is described in greater detail in subsequent sections.

1. Unpack the equipment in a staging area.
2. Assemble the operators desk.
3. Place the equipment in their respective locations.
4. Set any switches and jumpers as required.
5. Install and connect the power distribution system.
6. Install signal and control cables with terminators
7. Check power, signal and control cables
8. For each equipment turn off the individual power ON-OFF switch.
9. Connect the Uninterruptible Power Supply to designated mains power.
10. Connect the Power Distribution Unit SX520 to designated mains power.
11. Turn on the power to the terminal.
12. Order in which the power switches are turned on

2.2.2 Unpacking

Reserve a staging area of 4 by 4 meters. If the Operator Desk or the VSH 200 cabinet is selected, reserve additional space.

As you unpack, check out the equipment against the packing list. The part number, the type number, and the serial number are indicated on the label of each box. Record this information in a site configuration list.

Unpack the operator desk with associated desk items and check that all items are included per the shipping list. Record missing items and contact ABB Customer Service if any items are missing. Proceed with the mounting and assembly as instructed in the instructions provided with the shipment.

2.2.3 Place and Position the Equipment

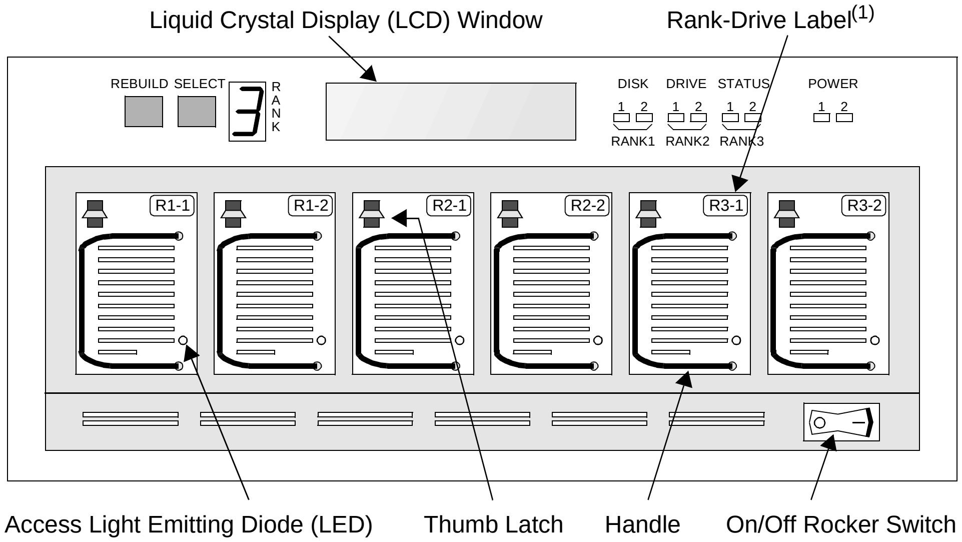
Once the operators desk with the monitor arm is assembled, checked and positioned, place the related equipment in the following order, and as instructed below:

1. Place the optional Uninterruptible Power Supply (UPS) below the operator desk.
2. Place the “UPS POWER” Distribution Unit SX520 as required.
3. Place the “MAINS POWER” Distribution Unit SX520 as required.
4. Place the monitor(s) on the extendable monitor arms (brackets).
5. Place the Advant Station system unit on top or below the operator desk.
6. Place the DAT Tape Drive on the operator desk temporarily.
7. Place the Universal and Annunciator keyboards on the operator desk.
8. Place the operators trackball to the right of the keyboard on the operator desk.
9. Place the Redundant Disk Array unit below the Advant Station system unit.
10. Place the printers on printer stands or desks.
11. Place the DAT Tape Drive in its permanent location.

2.2.4 Assembly of RDA Unit

Assembly consists of inserting two, four or six disk modules into the slots at the front of the subsystem frame.

1. Open the front door of the frame by releasing the fasteners and swinging the door downward. Figure 2-3 depicts the RDA unit with the door open.



(1) Rank-Drive Label may be user installed as required.

Figure 2-3. RDA Unit, Inside View

2. Insert each of the disk modules into one of the six slots, beginning at the left, and being careful that the connectors are properly and securely mated at the rear of the frame. Notice that the module's latch is thumb-operated and, when a disk unit is inserted, the thumb latch will "snap" into place. This locks the unit in position and turns the power ON.

NOTE

Normally, when disk modules are inserted under "hot" (power-on) conditions, the green LED will light, indicating that proper insertion has been accomplished. The lights will not light here, because power is not on.

2.2.5 Connecting to the Computer

1. Determine the configuration and SCSI ID number of each of the SCSI Host Adapters present in the Advant Station.
2. The RDA unit uses a single-ended SCSI interface with connections at the back of the unit. There should be a sticker on top of the SCSI connectors identifying the right interface for the unit.
3. Check the SCSI bus configuration. SCSI Host Adapters can accommodate a maximum of 7 devices each. The Advant Station system unit itself uses SCSI ID number 7. The root disk unit should be set to SCSI address 6.
4. Use the SCSI ID Switches in the back of the RDA unit to set the SCSI ID's. These ID's must be set to the addresses of the available taps you found in Step 3. There are two push-

buttons, one above and one below each ID indicator. Use the bottom button to *increase* the ID number and the top button to *decrease* the ID number. When facing the ID’s, the rightmost ID is associated with the first rank, the middle ID is associated with the second rank, and the leftmost ID is associated with the third rank.

5. Remember, each rank (pair) occupies one SCSI ID. Therefore, a fully configured RDA unit, with three ranks, occupies three SCSI IDs. Each of these IDs must be unique, and in the range of 0-6. You cannot use the Advant Station system unit’s ID number (or any other busy ID numbers) that you identified in step 3.
6. Make sure the Advant Station system unit is OFF. If the RDA unit is the first external device to be connected to the Advant Station system unit, plug the SCSI cable into the SCSI connector. Otherwise, remove the terminator resistor from the last unit on the SCSI bus to which the RDA unit is to be attached. Plug the SCSI cable on the receptacle left open by removal of the terminator resistor.
7. Connect the loose end of the SCSI cable installed in Step 6 to the back of the RDA unit. You can use either of the two receptacles in the back of the unit. Once you have connected the SCSI cable into one of the receptacles, plug the terminator resistor into the other one.

NOTE

Failure to use a terminator resistor on a SCSI Bus could result in malfunctioning of the devices attached to it.

Figure 2-4 shows the rear view of the RDA unit.

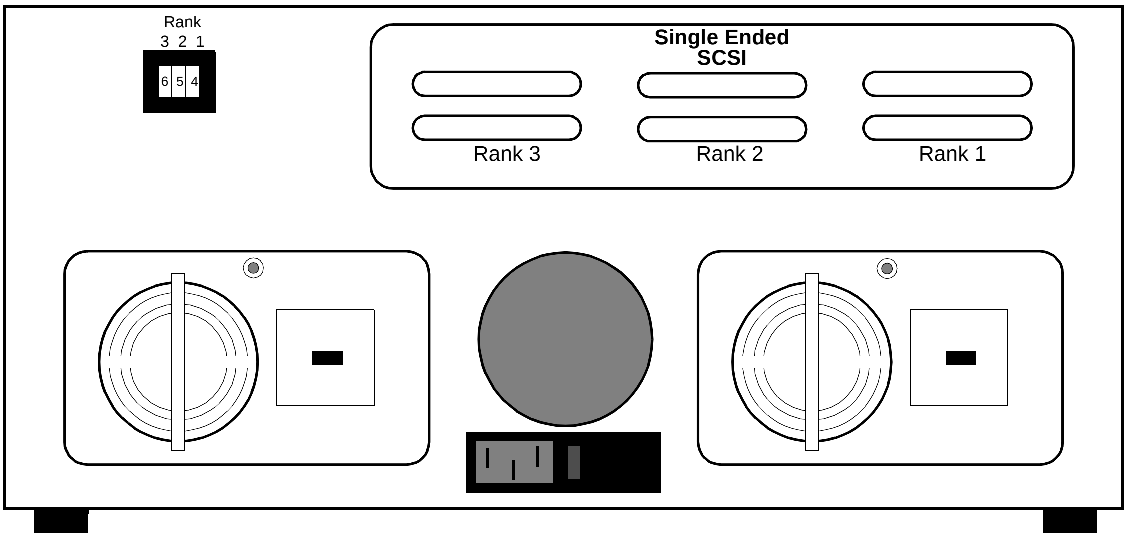


Figure 2-4. Rear View of RDA Unit

2.2.6 Switch Settings

2.2.6.1 RDA Unit Input Voltage Range Switch

Input voltage range for the RDA unit is switch selectable on each power supply unit. The power supplies are shipped configured for 115 V rms. In areas where 230 V rms. is used, you must change the range select switches to 230 V rms. The input voltage range select switch is located at the rear of the unit on each the power supply panels. Use a sharp tool to move the switch left for 230 V.

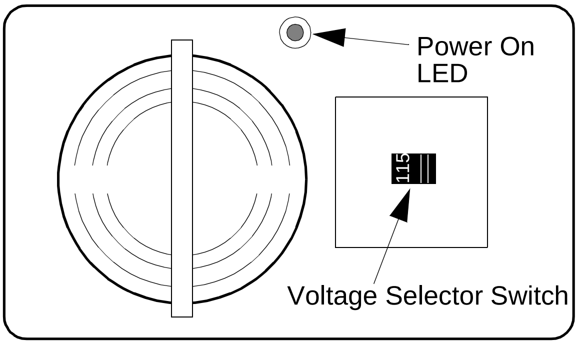


Figure 2-5. Input Voltage Range Select Switch on the RDA Unit.

2.2.6.2 SCSI Selector Switch

The SCSI ID Switches in the back of the RDA unit are used to set the SCSI ID’s. There are two push-buttons, one above and one below each ID indicator. Use the bottom button to *increase* the ID number and the top button to *decrease* the ID number.   When facing the ID switch, the rightmost ID is associated with the first rank, the middle ID is associated with the second rank, and the leftmost ID is associated with the third rank.

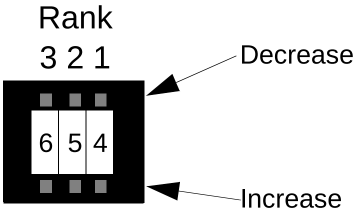


Figure 2-6. SSCI Selector Switch

2.2.7 Connectors

2.2.7.1 Advant Station Connectors

Connectors for networks, peripherals, monitors, etc. are provided on the rear of the Advant Station system unit, Figure 2-7.

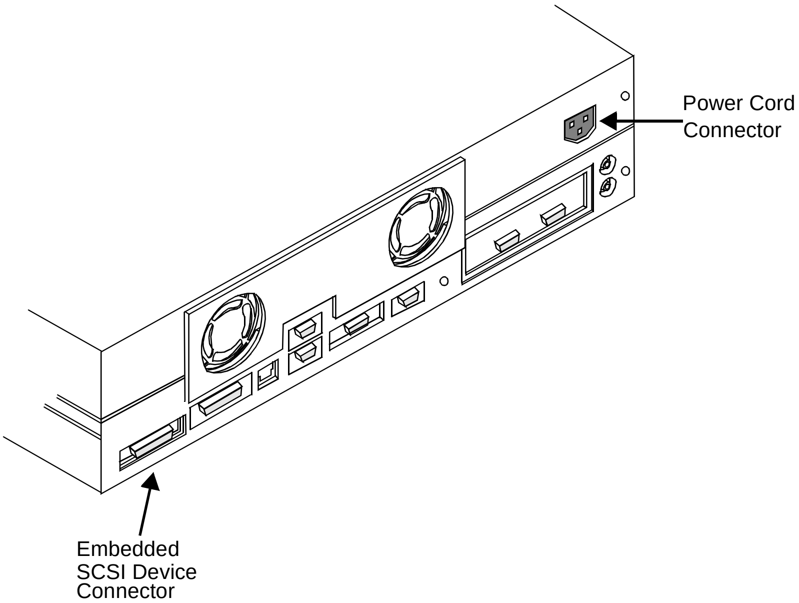


Figure 2-7. Rear View of Advant Station 515

2.2.7.2 RDA Unit Connectors

SCSI Interface connectors for the RDA unit are located at the rear of the unit. Figure 2-8 shows the connectors for SCSI bus connection.

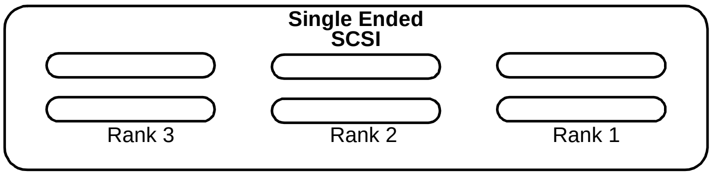


Figure 2-8. SCSI Bus Connections

2.2.8 Cable Connections

The RDA unit is connected to the Advant Station 500 Series workstation with a SCSI bus cable and powered by the distribution unit used by the workstation.

2.2.8.1 Power Connections

The power distribution system should be installed after the equipment has been assembled and mounted or placed in their respective locations. The power cables are installed and connected prior to the installation of the SCSI signal and control cables, to provide a ground path for electro static discharge. The static electrical potential can be high on some of the equipment.

Power connections are basically the same for 110 V ac and 230 V ac. A general view of the power connections is shown in Figure 2-9. A more detailed view is provided in Figure 2-10. The required power cord set for 110 V ac or 230 V ac applications is described in Table 2-2. The following are recommendations and guidelines for power connections:

- Provide 4 power wall outlets with individual power switches next to the outlet. Reserve 3 of the outlets for power to the Advant Station 500 series workstation. Reserve the remaining outlet for other equipment.
- The SX520 is specified for a maximum of 10 amps. Size the fuse of each wall outlet to 10 amps at 110 v.a.c. or 230 v.a.c. as required
- Connect line power from the power outlet to the primary SX520 power distribution unit.
- Route one IEC 320 power cord to the secondary power distribution unit SX520.
- Route one IEC 320 power cord to the optional Uninterruptible Power Supply SV520.
- From the Uninterruptible Power Supply (UPS) route a power cord to a secondary SX520 power distribution unit for critical loads.
- From the secondary SX520 power distribution unit providing uninterrupted power, reserve or route 3 power cords to such equipment as:
  - Advant Station system unit
  - A Color monitor
  - The RDA unit

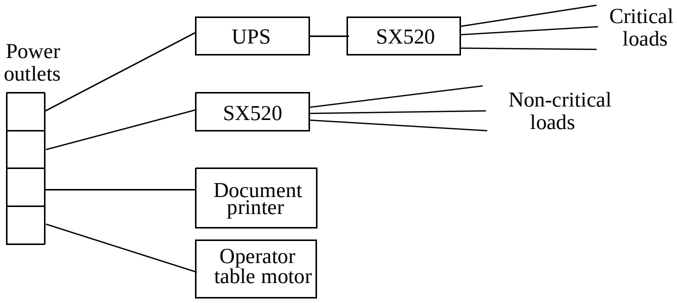


Figure 2-9. Power Connections, General View

Table 2-2. Power cord set according to IEC 320.

Type	Description of Cable	Article No
TK574	Power Cord Set with molded power connectors according to EN 60320 (IEC 320) 2.5 meters	3BSC950031R0025

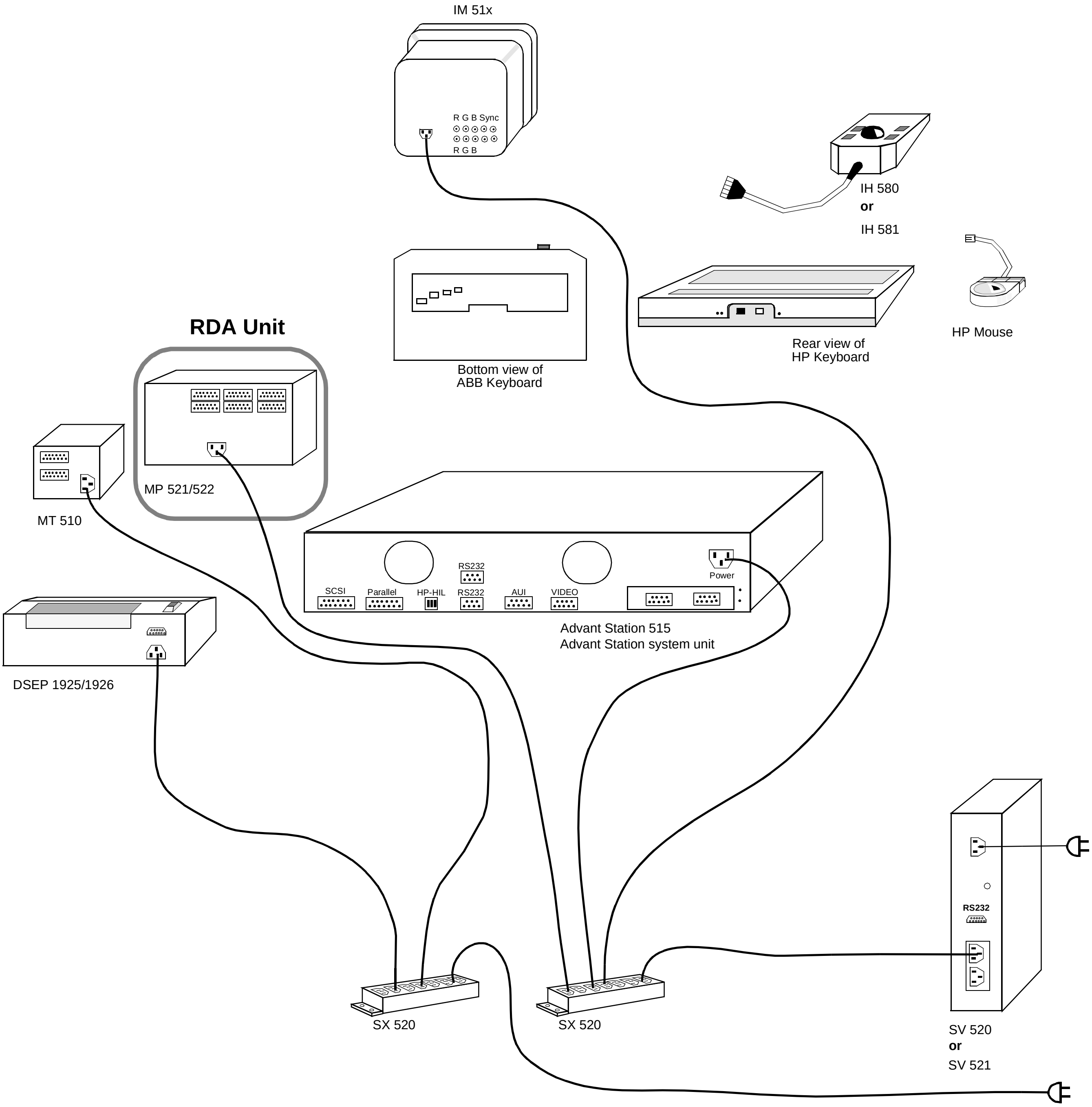


Figure 2-10. Power Connections, Detailed View

2.2.8.2 SCSI Device Connections

Internal SCSI devices, such as hard disks, are internally connected to the processor. External SCSI devices may be connected to the SCSI connector on the back of the Advant Station system unit. This connector is a high density connector. The Advant Station system unit will start up even if the SCSI connector is left empty, without a terminator. If external SCSI peripherals are connected, the last device must be terminated by the special low density “Termination Connector” TX503.

RDA Unit Connection

RDA unit connections are made to the SCSI (Small Computer Systems Interface) connector at the rear of the Advant Station system unit, Figure 2-11.

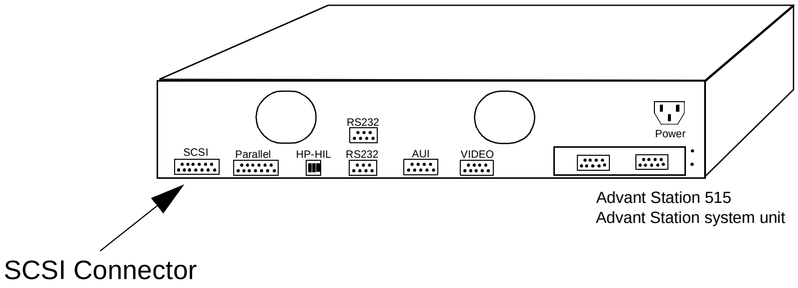


Figure 2-11. SCSI Connector for External Mass Memory

SCSI devices can be connected in daisy-chain fashion, Figure 2-12. The last device on the SCSI-II bus must be terminated by installing a low density SCSI-II bus terminator TX503 on the SCSI OUT connector of the last device.

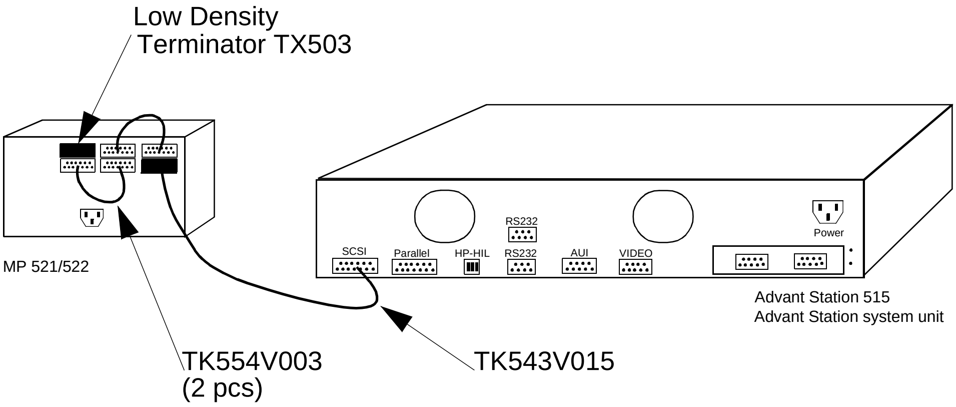


Figure 2-12. RDA Unit Connected to One Advant Station

Figure 2-13 shows the connection of the RDA unit to three Advant Station system units.

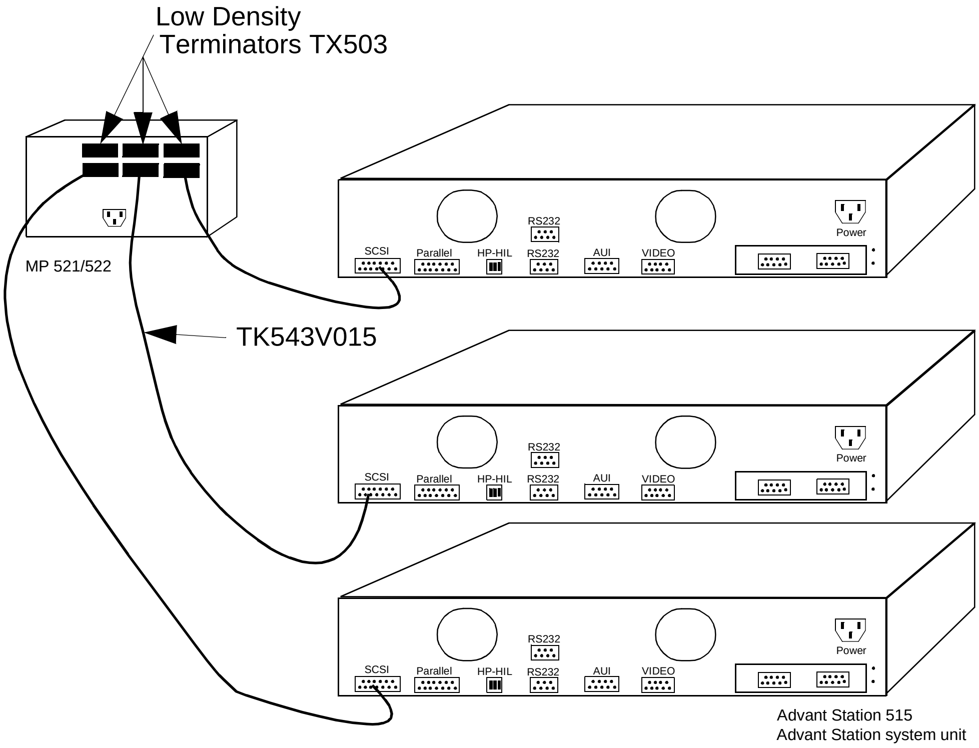


Figure 2-13. RDA Unit Connected to Three Advant Stations

The cable and terminator requirements are listed in Table 2-3 and Table 2-4.

Table 2-3. SCSI Connection Cables

Type	Description of Cable	Article No
TK543V015	Cable Assembly SCSI-II interface cable 1.5 meters. For connection of external SCSI-II units to the Advant Station system unit.	3BSC950038R0001
TK548V020	Cable Assembly. SCSI-II interface cable 2.0 meters. For connection between two external SCSI-II devices. Low density connectors at ends.	3BSC950046R0001
TK554V003	Cable Assembly. SCSI-II interface cable 304mm. For connection between two ranks of the RDA unit. Low density connectors at both ends.	3BUC950003R0001

Table 2-4. SCSI-II Low Density Terminator

Type	Description of Item	Article No
TX503	Active External Low Density SCSI bus Terminator.	3BSC840018R0001

2.3 Powering Up the System

2.3.1 Steps before Energizing the Power Outlet

Do the following steps **before** power is applied to any of the equipment of an Advant Station.

1. **Turn off** the individual equipment's power ON-OFF switches.
2. Connect the primary Power Distribution Unit SX520 to designated power outlet
3. Turn on the power at the power outlet.

2.3.2 Order in which the Power Switches are Turned On

Turn on the power switches in the following order:

1. Monitor
2. Uninterruptible Power Supply (UPS). The UPS needs a device power load to start up.
3. External Mass Memory Storage System (RDA Unit)
4. Printers
5. Advant Station system unit

2.3.3 Powering Up the RDA Unit

After all the connections have been made and SCSI ID switches set, turn the RDA unit ON to assure proper functioning of the hardware, prior to installation of the software.

NOTE

Always turn the RDA unit on before turning the Advant Station system unit on.

1. Press the rocker switch (front, lower right) to the **ON** position. The Liquid Crystal Display (LCD) window will be blank at this time, because the Advant Station system unit power is not on.
2. Check each of the Disk Drive Status LEDs and the two Power LEDs (should be green), to assure that all disk modules have been properly inserted.

3. At this time, turn on the Advant Station system unit. As the system unit boots, it will recognize the connection of the RDA unit. When booting is complete, the login prompt will appear. If formatting is required, login as root and immediately go to single user mode.

2.3.4 Formatting

If necessary, format, partition and make the corresponding file systems onto the RDA unit. The RDA unit supports the hard drive command set for the operating system software you are running on the Advant Station. Formatting and partitioning procedures, for example, are no different for the RDA than for any standard hard drive.

Refer to Section 4.4.2.1 Formatting for more information before starting a format procedure.

WARNING

Do not format a drive that may contain application software or information preloaded by ABB. Formatting will destroy all data on the disk.

2.4 Product Verification

2.4.1 Status and Information Screens

The LCD window provides vital information pertaining to the operation of the drives. In addition to status information regarding each drive, the number of I/O operations per second is displayed on this screen. This section will go into detail describing the information displayed on the screen and the operational status of the controller at the time.

2.4.1.1 Initialization Screens

These screens are displayed during initialization of the disk sub-system.

Self-Test Screen

This screen is displayed when the system is first turned ON. This indicates the subsystem is executing its internal power-up diagnostic routines to insure the hardware is working correctly.

```
Self-Test
```

Identification Screen

This screen is displayed after the self-test diagnostic has been completed. It identifies the product and the RDA unit firmware release. If you ever need to call ABB for support, make sure you know what firmware release you have before calling.

```
ECCS RAID Module
(c) 1993 R1.0.0A
```

Drive Characteristic Screen

This screen appears shortly after the Identification Screen. It informs the user how much disk storage is on-line and displays the SCSI Bus ID of this subsystem. In this example, the storage disk capacity is 1021 MB and the SCSI ID is 5.

```
ECCS RAID Module
1021 MB Online    ID 5
```

One MB equals 1,048,576 bytes, not 1,000,000 bytes.

2.4.1.2 Initialization Error Screens

If the following error screens appear, and there is no suggestion to correct the problem, write down all of the information from the screen and contact the ABB Customer Technical Support Hotline.

Host Adapter Error Screen

This screen appears if, during the self-test diagnostic, the controller will detect that a differential RAID Module is cabled to a single-ended Host Adapter.

```
DIFF Bus Connected
To S.E. Bus
```

NOTE

All RDA units provided by ABB are single-ended SCSI bus adapters.

RAM Failure Screen

This screen is displayed if an RAID FFT-1 RAM failure is detected during self-test diagnostic. Both drive LED indicators will alternately blink RED and GREEN.

```
TEST-01
RAM:0100   [ff]<>[a5]
```

The first line on the screen indicates which RAM test failed. There are 4 RAM Tests, identified as TEST-01, TEST-02, TEST-03 or TEST-04.

The second line indicates where the RAM failure has occurred. This information can be used by a technician to determine the cause of the problem.

SCSI Interface Failure Screen

This screen is displayed if a register access failure occurs during an attempt to access one of the SCSI Bus Interface Chips.

```
TEST-10
HA: 01   [ff]<>[a5]
```

The first line on the screen indicates which test failed. There are 3 SCSI Tests, identified as TEST-10, TEST-20 or TEST-30. The second line shows which register access failed and how.

Interrupt Failure Screen

This screen is displayed if the diagnostic that checks the interrupt signals fails. The first line on the screen indicates which test failed.

```
TEST-11
NO HA INTRPT RECEIVD
```

The second line indicates that the interrupt never occurred.

Hard Drive Absence

This screen is displayed if none of the hard disks could be accessed. The six drive indicator LEDs will be off. The disk subsystem will not function under this condition. Make sure each of the hard drives are properly inserted into the RDA unit and are powered ON. This condition can also be caused by loose SCSI cables. Once you have corrected the situation, reboot the RAID subsystem.

```
ECCS RAID Module
No hard drives
```

Hard Drive Mismatch Screen

This screen is displayed if there are any discrepancies (in hardware or firmware) between the two hard drives installed in the RAID subsystem for mirroring. The subsystem will only work if both drives are of the same type and capacity.

```
ECCS RAID Module
Hard Drive Mismatch
```

Format Required Screen

This screen will appear if the subsystem hard drives have not been low-level formatted. Read and write operations will be disallowed until the subsystem has received the FORMAT command from the host computer. All drive status indicators will show RED.

```
ECCS RAID Module
Format Required
```

Under these circumstances, some computer systems will not boot-up or recognize the RAID controller as a valid hard drive. Therefore, the RAID subsystem must be formatted before the operating system is booted.

NOTE

All drives supplied from ABB, whether stand-alone or in a RAID subsystem, have been pre-formatted.

2.4.1.3 Normal Operation Screen

This screen indicates normal operation for a selected rank. Both drives are on-line and the status indicator LEDs for both drives are GREEN. The information following the 1> indicates the status of drive 1. "ONLINE" indicates the drive is functioning normally. Likewise, the information following the 2> indicates the status of drive 2.

```
1> Online         IOPS
2> Online          74
```

Refer to Chapter 4 Operation, for more information during normal operation.

Chapter 3 Configuration and Application Building

This chapter is not applicable.

Chapter 4 Operation

4.1 Elements of RDA Unit

Since the RDA Unit is a hard disk subsystem, it requires very little day-to-day user interface. However, a System Administrator should be familiar with the unit's front panel and the various messages that appear on the LCD window during initialization and in cases of detected failures of the RDA unit, or of interconnected host equipment.

This chapter will describe some of the physical aspects of the RDA Unit and will give you an understanding of the unit's front panel.

4.1.1 Hard Drives

The RDA Unit is composed of three *ranks* (or pairs) of redundant hard disk units, each with its own controller. Each pair of drives contains the same data in each block.

Each 3 1/2" hard disk unit is mounted in a removable frame that slides in and out of the RDA Unit housing. When a disk unit is inserted, a thumb latch will "snap" into place. This locks the unit in position and turns the power ON.

WARNING

When removing a disk unit from the RDA unit, depress the thumb latch, carefully slide the unit partially out, and let the disk "wind down". After the disk stops spinning, the unit can be completely removed. Removing the disk unit in this manner will help to prevent head crashes and crash-related disk failures.

4.1.2 The Front Panel

The front panel consists of a combination of buttons, status indicators, and a liquid crystal display (LCD). The following figure is a depiction of the front panel.

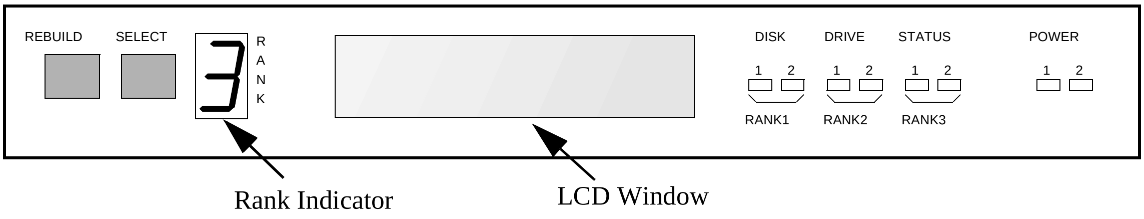


Figure 4-1. RDA Front Panel

4.1.2.1 Rebuild Button

When you press the **REBUILD** button, a rebuild signal is sent to each of the three controllers that control the three ranks (pairs) of disk modules. The rebuild signal is accepted only by a controller that has a failed disk (a red Rank light). The signal causes two functions to be sequentially attempted:

- Reformatting of the failed disk.
- Copying of all the mirrored data from the good disk of the pair to the failed disk.

See Section 4.4 for more information on the rebuilding process.

WARNING

Rebuilding a drive will destroy all data on that drive.

4.1.2.2 Select Button

Press the **SELECT** button to choose a rank. The Rank digital indicator next to the **SELECT** button displays the rank number that is chosen. Information relative to the currently selected rank is shown in the LCD display window.

4.1.2.3 Rank Indicator

The Rank indicator displays a single digit (either a 1, 2, or 3) representing one of the three ranks (pairs) of disks selected by pressing the **SELECT** button. When the digit is not blinking (stable), the information shown in the LCD window to the right is associated with that rank. When the digit is blinking, a change to a different rank is in progress.

4.1.2.4 Disk Drive Status Lights

The Disk Drive Status lights are tri-color lights that individually indicate the status of each of the physical disk drives. For each drive, the light can be green, amber, red or off. The interpretation is:

GREEN: Indicates the drive is in good operating condition and is working within established parameters.

AMBER: Indicates that a transient state is in effect. This means the drive is in transition from a failed state (RED) to a good operating state (GREEN), or from a failed state (RED) to another failed state (RED). The LED will be amber during drive rebuilding.

RED: Indicates that the drive has failed.

OFF: Indicates that there are no drives installed in that rank slot.

4.1.2.5 The LCD Window

The 20 column by 2 line Liquid Crystal Display (LCD) provides vital information pertaining to the operation of the drives. Each line in the display represents one of the paired disks in the rank that has been selected by the **SELECT** button. For example, under normal operating conditions, the window will display the word “Online” on both lines, indicating that the selected rank of disks is operating properly. To view the condition of another set of paired disks, the rank number of that pair of disks must be selected by pressing the **SELECT** button.

NOTE

If there has been a failure in another rank, the window display will not change until that rank has been selected by pressing the **SELECT** button.

In addition to status information regarding each drive, the number of I/O operations per second is displayed on this screen. See Section 4.3 for more detail describing the information displayed on the screen and the operation status of the controller at the time.

4.1.2.6 Power Lights

The Power Lights are green when the power supplies are operational.

A power light turns off when a power supply fails or is removed.

4.2 How to Use the Front Panel

The following is an example of how to use the Front Panel display:

1. Under normal operating conditions, the Rank indicator will be displaying one of the three digits, 1, 2, or 3. The Display window will indicate “Online” for each of the physical disks in the selected rank. The Disk Drive Status lights and the Power lights will all be green.
2. Suppose that the Disk Drive Status light number 2 in rank 3 turns red, indicating some type of failure.
3. Press the **SELECT** button until the digit 3 is displayed in the Rank indicator. When the digit stops blinking, the second line of the LCD window will indicate one of the error conditions for drive 2.
4. (See Appendix B for an explanation of error codes).
5. At this point, you should press the **REBUILD** button in an effort to affect a software fix by reformatting and copying all data from disk 1 to disk 2. In the interim, normal operation continues. Rebuild takes approximately 30 minutes.

WARNING

Rebuilding a drive will destroy all data on that drive.

6. If step 4 is unsuccessful, and you have a spare drive, then you can replace the disk 2 module and perform another rebuild. Contact ABB Customer Support regarding the failed drive.

4.3 Operational LCD Displays

This section presents the screens that are displayed during steady state operation. Steady state operation is the normal operating mode of the RDA unit during which media access I/O requests are executed.

4.3.1 Normal Operation Screen

This screen indicates normal operation for a selected rank. Both drives are online and the status indicator LEDs for both drives are GREEN. The information following the 1> indicates the status of drive 1. "ONLINE" indicates the drive is functioning normally. Likewise, the information following the 2> indicates the status of drive 2.

```
1> Online           IOPS
2> Online             74
```

4.3.2 Formatting Screen

This screen indicates that the RDA unit is being formatted by the Advant Station. The "elapsed time" indicates the length of time the drives have been formatting in hours:minutes. As a reference, a 1 GB RDA unit takes about 30 minutes to format. While the drives are formatting, their LEDs will be amber, and will flash alternately.

```
> Formatting...
 Elapsed Time:     0:17
```

WARNING

Do not remove the drives, or interrupt a drive format or copy.

4.3.3 Steady State Operation Error Screens

This section presents error screens which may be displayed during the steady state operation. Even though an error condition exists, the RAID subsystem will still be able to satisfy the I/O request from the Advant Station.

4.3.3.1 Rebuild Required Screen

This screen indicates that drive 2 needs to be rebuilt. Only drive 1 is currently functioning. The status indicator LED for drive 2 will be RED at this time. This screen will also appear if drive 2 has not been pre-formatted.

```
1> Online           IOPS
2> Rebuild req       121
```

4.3.3.2 Drive Missing Screen

This screen indicates drive 2 could not be located on the subsystem. Either the drive has completely failed, or the drive has been disconnected for repairs. The status indicator LED for drive 2 will be off.

```
1> Online           IOPS
2> Not Found          91
```

4.3.3.3 Drive Failure Screen

This screen indicates drive 2 has failed during operation. Correction of this fatal error probably requires replacement of the drive. The buzzer will sound every 10 minutes while the unit is in this state. The status indicator LED for drive 2 will blink RED. For more information about the meaning of the error codes, see Appendix B, "Drive Error Codes".

```
1> Online          IOPS
2> Fail 051202       45
```

4.3.3.4 Hard Drive Too Small Screen

This screen is displayed if there is a size discrepancy between the two hard drives installed in the RAID. The subsystem will only work if both drives are of the same size. The example below indicates that the first drive’s capacity is insufficient.

```
1> Too Small         IOPS
2> Online           157
```

4.3.3.5 Drive Mismatch Screen

This screen indicates that the drive inserted into slot 2 does not match the type of the drive in slot 1.

```
1> Online          IOPS
2> Mismatch          25
```

4.4 Rebuilding a Drive

When one of the disk drives in a rank fails, and that failed drive is replaced with a new drive, you must “rebuild” the new drive so that it mirrors the data on the rank’s remaining operational drive.

Drive rebuilding is a three-phase process. First, the new drive is initialized. The new drive is then formatted identically to the operational drive. Lastly, the contents of the operational drive are copied onto the new drive. After this operation has been completed, the RDA unit’s rank will be fully operational.

This section will guide you through the process of rebuilding a drive, starting from the failure of the original disk and ending with a fully functional subsystem.

4.4.1 Disk Failure

When one of the hard drives in a rank fails, the corresponding status indicator will turn from GREEN to blinking RED and the appropriate status line on the LCD will indicate a drive failure. An audible alarm will sound every 10 minutes while the unit is in this state. The error code displayed on the LCD can be used to determine the cause of the failure. This three part error code is explained in Appendix B, "Drive Error Codes" of this manual. The screen will appear as follows:

```
1> Online          IOPS
2> Fail 041202       45
```

In this example, drive 2 has failed. The error code 041202 indicates a hardware failure has occurred. In this case, you must call Customer Support for assistance.

NOTE

When a disk fails, write down all of the error information found on the LCD and attempt to rebuild the disk. See the next section, “Drive Rebuilding”.

If the disk fails again, write down all of the new error information found on the LCD and contact ABB Customer Support.

At this point, even with a failed drive, the disk subsystem will still operate. The Advant Station continues to run properly since it can still access the other disk.

If the Advant Station is rebooted without the failed drive, the following screen will appear on the LCD:

```
1> Online          IOPS
2> Not Found         91
```

The screen indicates drive 2 has been disconnected from the system. The drive 2 status indicator light will be OFF at this time.

Once the failed drive has been serviced or replaced, you are ready to rebuild the unit.

4.4.2 Drive Rebuilding

Press the **REBUILD** button on the front panel of the unit to start the reconstruction of the new drive. The drive 2 status indicator light will turn from RED to AMBER to indicate the operation has started. The first phase in the rebuilding process is initialization of the drive. This verifies that the drive is working correctly. The screen will appear as follows:

```
1> Online          IOPS
2> Initializing     21
```

This screen indicates drive 2 is being re-initialized after a drive replacement or a hot-swap has taken place.

NOTE

A hot-swap, in the context of a RAID subsystem, is defined as the removal and replacement of one hard drive without taking the subsystem out of service.

4.4.2.1 Formatting

The next phase in the rebuilding process is formatting. The format of the operational drive will be examined so the new drive can be formatted in exactly the same way. The LCD will look like this:

```
1> Online          IOPS
2> Formatting        18
```

WARNING

Do not remove the drives, or interrupt a drive format or copy.

This screen indicates drive 2 is being formatted. It takes place so as to guarantee the new drive being rebuilt has the same physical format as the operational drive. While the drive is formatting, its LED will be amber

The length of time required to format the new hard drive depends on the type and size of the drive. The larger the capacity of the drive, the longer it will take. This phase usually does not take more than an hour to complete. During the formatting phase, the performance of the subsystem will not be affected because this operation does not interfere with the operational drive.

4.4.2.2 Copying

After the formatting is completed, the copy phase begins; the contents of the operational drive are copied onto the new drive, updating it. The status light for the drive that is copying will blink AMBER. The LCD will reflect this as follows:

```
1> Online          IOPS
2> Copying 23%       22
```

WARNING

Do not remove the drives, or interrupt a drive format or copy.

This screen indicates the copying phase of the reconstruction process is taking place on drive 2. The status indicator LED for drive 2 will blink AMBER. The percentage indicates that 23% of the contents of the operational drive has been copied to the drive being rebuilt. When this number reaches 100%, the drive being rebuilt will be placed back online.

During this part of the rebuilding operation, performance of the Advant Station will be diminished slightly. This is due to the RAID controller satisfying requests from the host computer while, at the same time, copying the contents of one drive to the other.

To help increase the performance of the Advant Station at this time, all I/O requests from the host computer will be given highest priority while block copying commands will have the lowest.

The amount of time required to complete the copying phase depends on the speed and capacity of the hard drive and the number of I/O requests issued from the host computer during this time. If no requests have been issued, rebuilding a 1 GB hard drive will take no more time than the time it took to format the drive. When the copying phase finishes, the following screen will appear:

```
1> Online        IOPS
2> Copying Done       22
```

This screen briefly appears after all data has been copied from the operational drive to the new drive. This indicates drive 2 is now consistent with the other drive and is back online. The status indicator LED for drive 2 will change from AMBER to GREEN. This indicates the rebuild operation was successful and the RDA unit subsystem will become fully operational. When this occurs, both drives will be online as reflected by the status indicator LEDs (both GREEN) and the following screen:

```
1> Online        IOPS
2> Online         74
```

Chapter 5 Maintenance

5.1 Electrostatic Discharge (ESD) Precautions

Electrostatic discharge (ESD) can result from the buildup of static electricity on or around the components you handle. You can even carry a charge on your body, and the discharge of this energy through a component or your computer can cause damage to the system.

CAUTION

Observe the following precautions at all times during these removal and replacements tasks to prevent damage to the system components from ESD:

1. Wear a grounded static strap on your wrist to ensure that any accumulated electrostatic charge will be discharged from your body to ground.
2. Keep all uninsulated printed circuit boards/cards in their protective antistatic bags.
3. Handle all printed circuit boards/cards by their edges, once you have removed them from their protective antistatic bags.

5.2 Corrective Maintenance Definition

This section provides instructions for locating and dealing with problems that may occur during operation of the Redundant Disk Array with the Advant Station 500 series workstation.

The Advant Station provides the following resources to facilitate detecting faults in your equipment:

- front panel LED’s
- power on self test
- boot administration commands
- system acceptance test.

Please refer to the *Advant Station 515 Hardware User’s Guide* or the *Advant Station 520i Hardware User’s Guide* for details on maintenance procedures.

The Redundant Disk Array provides start-up and operational information on the front panel of the unit. Please refer to Chapter 2 Installation, and Chapter 4 Operation, for details of the information provided by the indicators and LCD display of the front panel.

5.3 Managing Your RAID Module

The Redundant Disk Array supports the hard drive command set for the operating system you are running on your Advant Station. Formatting and partitioning procedures, for example, are no different for the RDA unit than for a standard hard drive. Therefore, any application or administrative procedure can access the information stored on an RDA unit in a transparent manner.

5.3.1 Disk Drive Replacement

If a drive of a rank pair fails and cannot be restored to operation using the rebuild procedure, it must be replaced with a spare MP523 hard drive assembly.

To replace a drive assembly:

1. Open the front door of the frame by releasing the fasteners and swinging the door downward. Each 3 1/2” hard disk unit is mounted in a removable frame that slides in and out of the RDA Unit housing.
2. Determine which drive unit has failed by checking the LCD display and the status LEDs of the front panel. The status LED of the failed drive will be RED and the LCD display will indicate a drive failure on the selected rank.
3. To remove a disk unit from the RDA unit, depress the thumb latch, carefully slide the unit partially out, stop and let the disk “wind down”. After the disk stops spinning, the unit can be completely removed. Removing the disk unit in this manner will help to prevent head crashes and crash-related disk failures.
4. Insert the spare disk module into the same slot, being careful that the connectors are properly and securely mated at the rear of the frame. Notice that the module’s latch is thumb-operated. When a disk unit is inserted, the thumb latch will “snap” into place. This locks the unit in position and turns the drive’s power on.

NOTE

When a disk module is inserted under “hot” (power-on) conditions, the green Access LED will light, indicating that proper insertion has been accomplished.

5. Check the status LEDs and the LCD display. The status LED of the replacement drive should illuminate RED and the LCD display should show "Rebuild req".
6. Press the **REBUILD** button to start the rebuilding operation. Refer to Section 4.4 Rebuilding a Drive for more information.

5.3.2 Power Supply Replacement

The redundant power supply units are located at the rear of the cabinet. Rear access is required to remove these units.

The front panel Power indicators show the status of the power supplies. If either of the indicators is not illuminated, then that power supply is not functioning properly.

The power supplies can be replaced with power on or off to the RDA unit, with no interruption of operation.

To replace a power supply:

1. To locate the defective power supply at the back of the RDA unit. Look for the Power On LED that is not illuminated. That indicates that the supply is not operating correctly.
2. To remove the power supply, loosen the three attaching screws by turning them 1/4 turn counter-clockwise. Grasp the handle and pull back. The power supply can now be slide out of the cabinet.

3. On the replacement supply, check the Voltage Selector Switch. It must be set to the same position as the unit removed.
4. Place the unit in the guides and slide it toward the front of the cabinet. When it is near the back of the cabinet push it firmly into the RDA unit. The Power On LED should now illuminate.
5. Tighten the three attaching screws by turing each 1/4 turn clockwise. Replacement is now complete.

There are no voltage adjustments of the power supplies. Return a defective power supply for repair to ABB Service centers. Figure 5-1 shows the location of the Power On LED, Voltage Selector Switch and the attaching screws of the power supply unit.

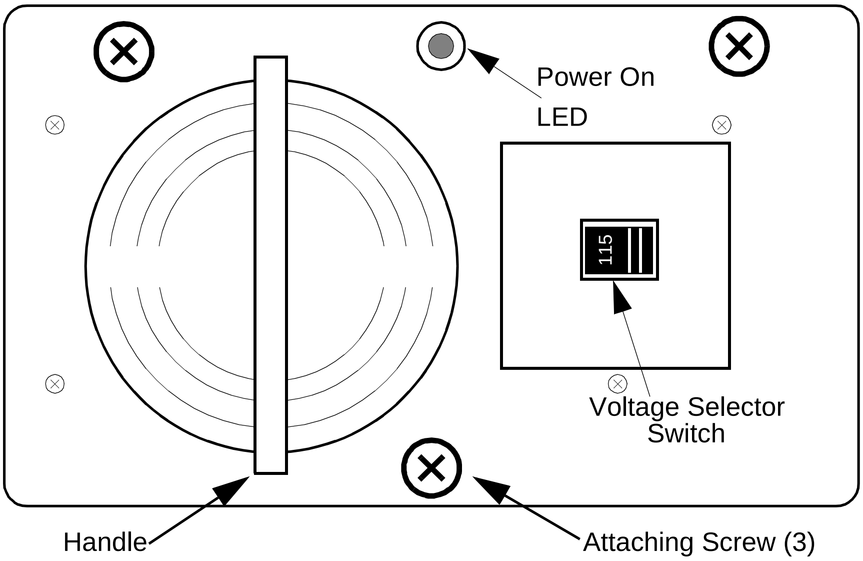


Figure 5-1. Power Supply Unit

Appendix A Specifications

A.1 Redundant Disk Array MP521 and MP522

The MP521 nd MP522 Redundant Disk Array units are identical except for cabinet mountings or as noted in table. The RDA units are intended for control room environments only.

Table A-1. RDA MP521 and MP522 Specifications

Characteristic	Data
OPERATING CHARACTERISTICS	
Drive set usable storage capacity	1.0 or 2.0 GBytes (each drive set)
Total usable capacity	6.0 GBytes
Drive capacity	6 (3 sets)
RAID level	1
Drive form factor	3.5 inch

PERFORMANCE (Disk Drive, Segate ST11200N)	
SCSI Protocol, interface	SCSI-2, single-ended
Transfer rate (MB/sec)	2.4 - 4.9
Average seek time (ms)	<10.5
Average latency (ms)	5.6
Spindle speed (rpm)	5,400
MTBF (hours)	300,000
MTTR (minutes)	5

POWER REGUIREMENTS	
Voltage (ac) (switch select)	115/230
Frequency (Hz)	47 - 63
Current draw (Amps)	3.0 max.
Power output (watts)	200(1)

Table A-1. RDA MP521 and MP522 Specifications

Characteristic	Data
ENVIRONMENTAL SPECIFICATIONS(2)	
Operating temperature range (°C)	5 - 45
Non-operating temperature range (°C)	-40 - 70
Operating relative humidity	10% to 90% non-condensing
Cooling (#Fans-Avg. cfm/fan)	3-50
PHYSICAL CHARACTERISTICS	
Height	222 mm (8.75 inches)
Width	482 mm (19.00 inches)
Depth	559 mm (22.00 inches)
Weight	29 kg (64 lbs)
Mounting MP521	482 mm(19") EIA Standard
Mounting MP522	Table top
APPROVALS	
Regulatory approvals	UL, FCC, TUV, CSA

(1) With one (1) rank installed. Each additional rank (2 drives) adds 18 watts.
(2) Intended for control room environments.

Appendix B Error and Sense Codes

B.1 Drive Error Codes

This appendix is provided to explain the meaning of the error codes that may be displayed by the RAID controller in the LCD window during drive failure.

An error code consists of six hexadecimal numbers which are logically divided into three sets of two numbers each. These three sets are known as the sense key code, additional sense code, and additional sense code qualifier, respectively.

NOTE

Error codes can originate from two sources; the RAID controller or the hard drive. The error codes listed here are returned by the RAID controller only, *not* by the hard drive. If the drive fails and the error code displayed is not found here, the code originated from the hard drive.

Contact the ABB Customer Technical Support Hotline.

B.2 Sense Key Code

The sense key code determines the type of error that has occurred whether it be a hardware failure, such as the servo mechanism, or a media error, such as a bad block. The following table describes the meaning of each possible sense key code. The only non-standard sense key code listed here is `0f` which is reserved for use by the RAID controller.

Table B-1. Sense Key Codes

Code	Error	Detail
00	No Sense	No specific error has occurred. This is returned if error information is requested and no error has occurred.
01	Recovered Error	The last command issued was completed successfully, but some error recovery action was required on the part of the disk controller. This error most likely indicates that a soft error has occurred. This means that the data read from the disk contained some errors which were corrected by the controllers using ECC. This block is a candidate for remapping because sometime in the future this block may fail completely.

Table B-1. Sense Key Codes

Code	Error	Detail
02	Not Ready	The drive is not ready for media access commands. Examine the additional sense code and additional sense code qualifiers to find out why the drive is not ready.
03	Medium Error	A media error has occurred. This is a non-recoverable error. The controller attempted to correct the data using ECC but the damage was too severe.
04	Hardware Error	Indicates a hardware failure has occurred. To find out exactly what has failed, it is important to examine the other two sets of numbers. This usually means that the drive requires replacement.
05	Illegal Request	Indicates there was an illegal parameter in the command issued to the drive or in the additional data supplied with the command.
06	Unit Attention	Indicates the drive may have been reset or removed and replaced in the RAID subsystem.
07	Data Protect	An I/O request to write data to the drive was rejected because the media was write protected. The write protect jumper on the hard drives should be disabled.
08	Reserved	This code is not used by direct access devices such as hard drives.
09	Vendor Unique	This code is unique for each manufacturer. To find out exactly what this code indicates, the OEM manual for the hard drive must be examined.
0a	Copy/Compare Aborted	A COPY or COMPARE command was aborted because an error was detected on the source or destination device. Neither the COPY nor COMPARE SCSI commands are supported by this RAID controller.
0b	Aborted Command	Indicates the controller has aborted an I/O request because of some internal error.
0c	Reserved	This code is not used by direct access devices such as hard drives.

Table B-1. Sense Key Codes

Code	Error	Detail
0d	Reserved	This code is not used by direct access devices such as hard drives.
0e	Miscompare	Used by the VERIFY and READ DATA BUFFER commands to indicate that the source data did not match the data read from the disk.
0f	Reserved RAID Special	This code is not used by direct access devices such as hard drives. However, this code is used by the RAID Module for internal error reporting purposes. If this appears on the LCD, then the error condition was detected by RAID controller and not by the hard drive.

B.3 Additional Sense Code

The additional sense code provides further information regarding the error. For instance, this can identify exactly which hardware mechanism failed.

B.3.1 Firmware Origination Code

If the sense key code has a value of 0f, then the additional sense code represents the ***firmware origination code***. This code identifies which target module and logical routine detected the error condition. The following table describes the meaning of each possible firmware origination code.

Table B-2. Firmware Origination Codes

Code	Firmware	Detail
00	Target SCSI Driver	WD33C93 initialization code. Waiting for chip to become ready to be RESET
01	Target SCSI Driver	WD33C93 initialization code. Indicates time-out occurred waiting for RESET interrupt to occur.
02	Target SCSI Driver	Selection command failed attempting to issue a command to a target hard drive.
03	Target SCSI Driver	Selection command secondary failed attempting to issue a command to a target hard drive.

Table B-2. Firmware Origination Codes

Code	**Firmware**	**Detail**
04	Target SCSI Driver	Selection command returned, unexpected SCSI Bus phase has occurred.
05	Target SCSI Driver	Unexpected SCSI Bus phase has occurred after IDENTIFY message has been sent.
06	Target SCSI Driver	Reselection time-out has occurred. Drive attempted to RESELECT but did not respond to the controller’s acknowledgment.
07	Target SCSI Driver	Programmed I/O data transfer to the hard drive did not complete within the allotted time limit.
08	Target SCSI Driver	SCSI Bus error occurred after PIO data transfer.
09	Target SCSI Driver	Programmed I/O padding function timed out.
0a	Target SCSI Driver	SCSI Bus error occurred after PIO pad.
0b	Target SCSI Driver	Programmed I/O data transfer from the hard drive did not complete within the allotted time limit.
0c	Target SCSI Driver	SCSI Bus error occurred after PIO data transfer
0d	Target SCSI Driver	Programmed I/O read padding function timed out.
0e	Target SCSI Driver	SCSI Bus error occurred after PIO read pad.
0f	Target SCSI Driver	RAID controller timed out waiting for status from the last command to be sent
10	Target SCSI Driver	Unexpected SCSI Bus phase has occurred.
11	Target SCSI Driver	Unexpected SCSI Bus phase has occurred.
12	Target SCSI Driver	Unexpected SCSI Bus phase has occurred.
13	Target SCSI Driver	Issuing command to hard drive time out.

Table B-2. Firmware Origination Codes

Code	Firmware	Detail
14	Target SCSI Driver	SCSI Bus error occurred after command was issued.
15	Target SCSI Message Handler	Time-out occurred waiting for IDENTIFY message to be sent to the hard drive. ATN asserted after message sent. Expected to send SYNCHRONOUS DATA TRANSFER REQUEST next.
16	Target SCSI Message Handler	Time-out occurred waiting for IDENTIFY message to be sent to the hard drive. ATN asserted after message sent. Expecting CDB next
17	Target SCSI Message Handler	Time-out occurred waiting for message to be sent to hard drive. This is used whenever any message other than an IDENTIFY message is to be sent such as the SYNCHRONOUS DATA TRANSFER REQUEST.
18	Target SCSI Message Handler	Time-out occurred waiting for a message from the hard drive.
19	Target SCSI Message Handler	Time-out occurred waiting for an ATN to be asserted.
1a	Target SCSI Message Handler	Time-out occurred waiting for an ACK to be de-asserted.
20	Tasks	Time-out occurred waiting for drive to enter STATUS phase.
21	Tasks	Time-out occurred waiting for drive to finish writing buffer to media.
30	Data Flow Switch Manager	Time-out occurred waiting for a DMA data transfer from the Host computer to both hard drives to complete.
31	Data Flow Switch Manager	Host SCSI chip timed out during DMA transfer.
32	Data Flow Switch Manager	Target SCSI chip timed out during a DMA data transfer.

Table B-2. Firmware Origination Codes

Code	Firmware	Detail
33	Data Flow Switch Manager	Time-out occurred waiting for next SCSI phase to occur after a DMA data transfer has completed.
34	Data Flow Switch Manager	Target SCSI chip timed out during a DMA data transfer.
35	Data Flow Switch Manager	Host SCSI chip timed out during DMA transfer.
36	Data Flow Switch Manager	Host SCSI chip timed out during DMA transfer.
37	Data Flow Switch Manager	Target SCSI chip timed out during a DMA data transfer.
38	Data Flow Switch Manager	Time-out occurred waiting for next SCSI phase to occur after a DMA data transfer has completed.
39	Data Flow Switch Manager	Target SCSI chip timed out during a DMA data transfer.
3a	Data Flow Switch Manager	Host SCSI chip timed out during DMA transfer.
3b	Data Flow Switch Manager	Time-out occurred waiting for next SCSI phase to occur after a DMA data transfer has completed.
40	Error Handler	SCSI Protocol error has occurred.
50	Drive Reconstruction	Format operation timed out. A drive is allowed two hours in which to format. Failure to format within this time period will result in this error.
70	Target SCSI Driver Manager	Time-out occurred waiting for a PIO I/O request to be issued to the hard drives.
71	Target SCSI Driver Manager	Unexpected SCSI Bus phase has occurred. DATA IN or DATA OUT was expected.
72	Target SCSI Driver Manager	Time-out occurred waiting for a DMA I/O request to be issued to the hard drives.
73	Target SCSI Driver Manager	Unexpected SCSI Bus phase has occurred. DATA IN or DATA OUT was expected.
74	Target SCSI Driver Manager	Unexpected SCSI Bus phase has occurred. DATA IN or DATA OUT was expected.

B.4 Additional Sense Code Qualifier

The additional sense code qualifier provides even more detailed information about the error.

B.4.1 WD33C93A SCSI Interface Chip Status Code

If the sense key code has a value of 0f, then the additional sense code qualifiers represent the *WD33C93A SCSI Bus Interface Chip status codes.*

Table B-3. WD33C93A SCSI Interface Chip Status Codes

Code	Detail
00	This code indicates that the WD33C93 SCSI Bus Interface chip was reset. This can happen as a result of an extremely high level of bus noise usually associated with the absence of terminators. ElectroStatic Discharge (ESD) can also cause this error to occur.
18, 28 48, 88	An unexpected DATA OUT phase has occurred.
19, 29 49, 89	An unexpected DATA IN phase has occurred.
1a, 2a 4a, 8a	An unexpected COMMAND phase has occurred.
1b, 2b 4b, 8b	An unexpected STATUS phase has occurred.
1c, 2c 4c, 8c	An unexpected unspecified information out phase has occurred.
1d, 2d 4d, 8d	An unexpected unspecified information in phase has occurred.
1e, 2e 4e, 8e	An unexpected MESSAGE OUT phase has occurred.
1f, 2f 4f, 8f	An unexpected MESSAGE IN phase has occurred.
22	Current command was aborted.
25	A data transfer was aborted due to the possibility of corrupt data.
40	The SCSI Bus is in such a state that commands issued to the WD33C93 are rejected.

Table B-3. WD33C93A SCSI Interface Chip Status Codes

Code	Detail
41	The hard drive disconnected from the bus (went to a BUS FREE phase) during an I/O request at an inappropriate time. This could indicate that the connection between the RAID controller and the hard drive has severed or the power supply to that drive failed.
42	Indicates that the RAID controller attempted to SELECT the hard drive to begin an I/O request but was not successful. This can also indicate that the SCSI connection was either severed or the power supply to that drive failed.
43	A SCSI parity error was detected.
44	A SCSI parity error was detected.
46	Unknown SCSI device has SELECTED the RAID controller on the Target SCSI Bus.
47	A SCSI parity error was detected during a STATUS phase.
85	Indicates that the hard drive controller went to a BUS FREE phase unexpectedly. This usually means that the drive's power supply failed or the drive controller has crashed and has released all SCSI Bus lines.

Appendix C Controller Codes

C.1 Controller Error Codes

This appendix lists the possible sense key/additional sense code/additional sense code qualifier values returned by the RAID controller. Some commands issued to the RAID controller are executed by the controller and *not* by the hard drive. In these cases, if an error occurs, the RAID controller will generate the contingent allegiance condition. Sense data is generated by the controller and returned to the initiator in response to the Request Sense command. In other cases, the RAID controller checks the arguments of the received CDBs and rejects them if necessary. Again, the sense data is generated by the RAID controller and *not* by the hard drives

The error codes listed here have the following format: sense key-additional sense code-additional sense code qualifier.

Table C-1. Controller Error Codes

Error Code	Detail
02-04-00	Drive is not ready, cause is not reportable.
02-04-01	Drive is not ready, but it is in the process of becoming ready.
02-04-04	Drive is not ready, format is in progress.
04-43-00	Message error detected.
04-44-00	Internal Hardware or Drive Protocol error.
04-47-00	SCSI Parity error detected.
04-49-00	Invalid message error.
05-04-04	Illegal Request, format is in progress.
05-20-00	Invalid command operation code.
05-21-00	Logical Block address out of range.
05-24-00	Invalid field in CDB.
05-25-00	Logical Unit not supported.
06-00-00	Unit Attention, drive taken off-line and replaced with another.
06-29-00	Unit Attention caused by a Power ON, SCSI Bus Reset, or a BUS DEVICE RESET message.

If an error code is returned that is not listed here, the code originated from one of the hard drives. Examine the hard drive's respective Original Equipment Manufacturer (OEM) Technical Reference Manual for more information.

Appendix D Glossary

assert

A signal driven to a true state.

bit

A binary digit.

byte

Eight consecutive binary digits.

C/D

Control/Data signal.

failed drive

This indicates that the hard drive is no longer functioning. The RAID controller does not recognize this drive as sane and will no longer attempt to access it.

fully operational

This condition indicates that both drives are on-line.

glue logic

Logic whose purpose is to interface the major logic blocks to each other.

Host SCSI Bus

The SCSI Bus that connects the RAID controller to the host computer.

initiator

A host computer system that requests an operation to be performed by a target.

negate

A signal driven to a false state.

new drive

This indicates that a particular hard drive residing in the subsystem was just installed. The drive is operational but is not up-to-date with respect to the sane drive. The drive must be reconstructed before it can be considered in a sane state.

non-waiting write

The write request is accepted by the controller without waiting for the write operation to the disk to be completed.

plug-and-play

A term used to describe the ease with which a SCSI device can be connected to a computer system and be made to work.

rank

A pair of disk drive modules.

sane or **sanity**

This condition is used in referring to a hard drive in the subsystem. A hard drive that contains the most up-to-date information is considered sane. If both hard drives contain the same information, both hard drives are considered sane.

SCSI ID

The bit-significant representation of the device’s SCSI address, ranging from 0 to 7.

steady state

Indicates that the RAID controller is in such a state that it can service SCSI I/O requests from an initiator.

toggle

To switch back and forth between options.

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